



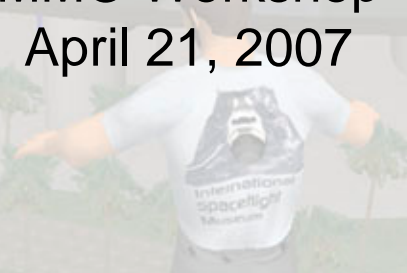
# Hubble Space Telescope Project

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# The HST Diverse House

Level 1: Hardware development

Level 2: Operations



End user - Science community



iclipart.com



Data production - quality & volume



# Who's in the House

~ 900 People strong!

## *Technical Disciplines:*

- Engineers - electrical, mechanical, thermal, contamination, propulsion, software, operations, systems
- Mathematicians with strong engineering background
- Scientists
  - Space Telescope Science Institute (STScI)

## *Management - multiple levels within HST:*

- Engineering technical management
- Program Management
- STScI instrument scientists







# Progressing Up the Ladder within HST



HST construction began in the 1980's and the Program has maintained a marching army for ~25 years

- Has allowed for grooming of management from the ground up within the Project



# HST Management Tracks

## *Hardware Engineering*

### Front-line technical managers

- Oversee the design and production of flight hardware
- All matrixed from Code 500
- Diverse education backgrounds (B.S. to Ph.D)
  - Aerospace, mechanical, mathematics, physics, astronomy
- All promoted within the HST framework
  - Many are converted contractors

### Project managers

- Code 400 personnel
- All started with technical degrees
- All have participated in NASA management training courses



# HST Management Tracks

## *Operations*

- Front-line technical managers
  - Oversee health & safety of all subsystems (e.g., power, pointing, thermal, communications, data management) of spacecraft and its on-board instruments
  - Diverse education backgrounds (B.S. to Ph.D)
    - Aerospace, mechanical, mathematics, physics, astronomy
    - None have business management degrees
  - All have 10+ years with HST
  - All matrixed from Code 500 (Systems Engineering)
  - Several promoted within the HST framework (in between servicing missions)
- Project managers
  - Code 400 personnel
  - All started with technical degrees
  - All have participated in NASA management training courses



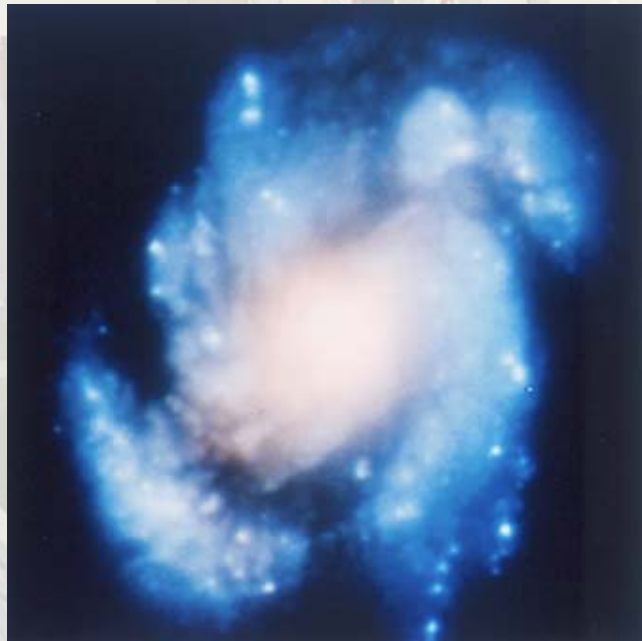
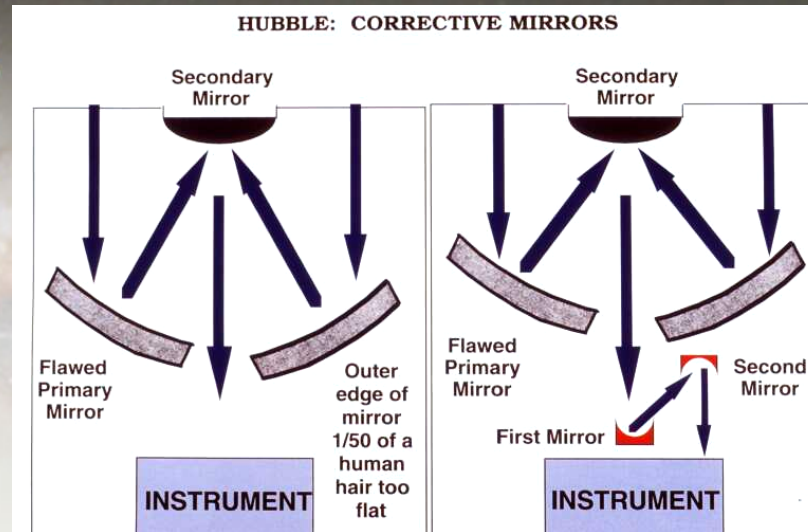


# Past HST Challenges

<b><i>Problem</i></b>	<b><i>Identification &amp; Solution Process</i></b>	<b><i>Skill Set Needed</i></b>
Spherical Aberration	International conference to brainstorm	Hired many h/w engineers, ops engineers, & scientists
RWA anomaly just prior to SM3B	PCS Engineers found problem in data; Tiger team formed; decision to replace RWA ('last minute' manifest change)	Consulted with the vendors since expertise not in-house
No shuttle/astronauts for SM4	RFI for ideas (wide variety of responses); HRV mission created (robotics); proposal for partnering to build system	Altered skill mix in-house & created new contracts for robotics experts, industrial & optical engineers
Instrument failures on-orbit	Formed Anomaly Resolution Boards (ARBs); fault tree analysis	In-house & national experts



# HST Spherical Aberration Solution







# Future Challenges

- Low Cost Operations
  - Budget
  - People downsizing
    - Losing Hardware part of the house
    - Need creative operational ideas (more automation)
- Unanticipated spacecraft failures
  - HST is 18 yrs old
  - Instruments mission success is 5 years but...
  - Operational workarounds



# Personal NASA/HST Experience

## *Why NASA?*

- World-wide respected agency
- Cutting edge technology
- Technical diversity for a mathematician
- Graduate level education included

## *Why HST?*

- Imagery of the science, initially
- Challenge of the work
- Diversity of the work
- Promotion potential

